

The Implicit Adaptation to Temporal Regularities

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Our environment often contains useful information about temporal regularities: whether it is a traffic light changing, or the elevator reaching its destination. In the presence of such regularities, we form temporal expectations to anticipate and prepare for relevant events. In the lack of such information, we are required to sustain higher levels of vigilance to respond to unpredictable events.

In the current study, we combined behavioural and pupilometry measures to investigate the cognitive mechanisms for adapting to implicit temporal regularities in a Continuous Performing Task designed to measure Sustained Attention. Individuals detected occasional targets embedded in an ongoing stimulus stream with different levels of temporal predictability of stimulus onsets in different task epochs. The results revealed evidence for preparatory behaviour in the presence of temporal regularities, reflected in phasic changes in pupil diameter preceding stimulus onset. The magnitude of rapid pupilometry changes also predicted the response type on each trial. In epochs where intervals were randomised, the overall mean pupil size was significantly larger compared to other epochs. We believe this adjustment reflects an adaptive process relying on the coeruleus–noradrenergic system in regulating task engagement when uncertainty is increased.

Our findings provide evidence for cognitive adaptation in response to different levels of temporal regularities. Individuals increase their alertness when targets are unpredictable, and prepare for their appearance when they are predictable. These observations enhance our understanding of the underlying processes of variations in performance over time, by revealing dynamic shifts in cognitive modes in response to varying uncertainty.